

SECTION 90

ELECTRICAL DISTRIBUTION

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4 90.1 REFERENCES

5 (90A) WASHINGTON STATE FERRIES, *Vessel Design Standards for Drawings Using*
6 *AUTOCAD (latest version)*

7 (90B) USCG NVIC 2-89, *Guide for Electrical Installations on Merchant Vessels and*
8 *Mobile Offshore Drilling Units*

9 (90C) IEEE STD 519, *IEEE Guide for Harmonic Control and Reactive Compensation of*
10 *Static Power Converters*

11 (90D) Code of Federal Regulations - 46 CFR Sub-chapter H

12 (90E) Code of Federal Regulations - 46 CFR Sub-chapter J

13 90.2 INTRODUCTION

14 This Section contains the Contractor Design and Provide general requirements for the
15 electric power distribution systems and equipment.

16 *For WSF Fleet-wide Standardization purposes, End No. 1 of the Vessel shall always be*
17 *considered the bow, and this designation shall delineate port and starboard, fore and aft*
18 *wherever they are addressed in the Technical Specification.*

19 90.3 GENERAL

20 Distribution systems shall meet the quantity and load rating of all electrical equipment
21 required to complete the electric plant. The electrical power distribution systems shall
22 include all electrical cabling, wiring, transformers, distribution panels, control switching
23 equipment, protective devices and automatic bus transfer equipment sufficient to make a
24 complete, functional and fully operational electrical power distribution system. See
25 **FIGURE 90-1** attached to the end of this Technical Specification Section. **FIGURE 90-1**
26 is a system overview which illuminates salient features of the system.

27 The distribution system shall include an Emergency Distribution Power system. Under
28 normal conditions, the final emergency power distribution loads shall be fed from the Ship's
29 Service Switchboard and shall be connected to the final emergency power source during
30 periods when the normal Ship's Service Power has been interrupted.

1 All protective devices shall be selected and arranged so as to isolate any fault in the system
2 vital to operation of the Vessel with the least possible portion of the system's service being
3 interrupted.

4 Electrical equipment and components shall be located in a manner that will most readily
5 facilitate operation and allow for ease of maintenance. Doors and panels must be capable of
6 being opened a minimum of ninety (90) degrees to facilitate maintenance and repair.
7 Sufficient clear space shall be left in front of all major electrical cabinets to allow removal of
8 the largest internal components and meet all Authoritative Agency requirements.

9 The Contractor remains wholly responsible for ensuring that the loads are correctly
10 connected within the distribution systems. The Contractor shall ensure that the design and
11 installation of electrical circuits and systems complies with the requirements of Reference
12 (90E) and other cognizant regulatory documents and agency requirements, and that circuits
13 and systems are in every respect complete, functional, and fully operational at the time the
14 Vessel is delivered to WSF.

15 A SQUARE D Powerlink® G3 NF2000G3, or equal, (**NOTE: *This system requires the***
16 ***Ethernet version of the Powerlink® controller instead of the N2 bus controller***) single pole
17 remote operated circuit breakers system shall be provided for some lighting or otherwise
18 specified circuits. The intent is to remotely control, both individually and in groups, circuit
19 breakers in general lighting panels and emergency lighting panels from the EOS and
20 Pilotheuses through system integration with the HVAC Control System (HCS). See Sections
21 12, 92, 95, and 101 of the Technical Specification for additional control requirements. See
22 Section 87 of the Technical Specification for additional requirements as to installation and
23 construction.

24 **90.4 SHIP'S ELECTRICAL DISTRIBUTION SYSTEMS**

25 **90.4.1 General**

26 Provide a complete and fully functional electrical power distribution system which shall
27 include all electrical cabling, switchboards, motor control centers, batteries, wiring,
28 transformers, distribution panels, disconnects, switches, control switching equipment,
29 protective devices, automatic bus transfer (ABT) equipment, hangers, junction boxes,
30 stuffing tubes, transits and other items and devices as are required to make a complete,
31 functional and fully operable electrical power distribution system.

32 The system shall include a Ship's Service Distribution system, and a Final Emergency
33 Distribution system. See **FIGURE 90-1** at the end of this Technical Specification
34 Section.

35 For WSF Fleet-wide Standardization purposes, except for electrical cabling, and unless
36 specified otherwise elsewhere in the Section or other Sections of the Technical
37 Specification, all distribution system components including panels, circuit breakers,

switches, enclosures, and indicators shall be manufactured or distributed by the SQUARE D Company. Requests for specific deviations from this requirement, must be submitted in writing to the WSF Representative.

90.4.2 Distribution System Voltages

The three (3) Ship's Service Generator Sets produce power at 480 Vac, 3-phase, 3-wire (delta connected), 60 Hz. This voltage is distributed by the Ship's Service Switchboard. The Ship's Service Switchboard may also be fed by one (1) of the two (2) Shore Power connections. These sources supply the switchboard with 480 Vac, 3-phase, 3-wire (delta connected), 60 Hz. The Ship's Service Distribution system shall be 480 Volt, 3-phase, 3-wire (delta connected), 60 Hz.

The Ship's Service Switchboard distributes 480 Vac to motor control centers, individual motor controllers and power panels, and power and lighting load centers. The power and lighting load centers shall be 208Y/120 Vac, 3-phase, 4-wire (grounded neutral), 60 Hz.

The Emergency Switchboard is divided into two (2) distribution sections. The primary section is supplied at 480 Vac, 3-phase, 3-wire (delta connected), 60 Hz, by either the Ship's Service Switchboard, or the Emergency Diesel Generator. The secondary section is supplied at 208Y/120 Vac, 3-phase, 4-wire, 60 Hz, by a transformer bank fed from the primary section of the Emergency Switchboard. This is the "Final Emergency Power" system.

All sources of electrical power shall have nominal voltage ratings of 480V, 208V and 120V as applicable. Nominal voltage at lamps and other power consuming equipment shall be 460V, 200V and 115V as applicable. See Section 87 of the Technical Specification for additional requirements as to installation and construction.

90.4.3 Ship's Service Power Distribution System

Provide a Ship's Service Power Distribution system to the Vessel's 480 Vac non-emergency loads through the Ship's Service Switchboard.

The Ship's Service Power Distribution system is comprised of the Ship's Service Switchboard and distribution that can be energized from the Ship's Service Diesel Generators or Shore Power. The Ship's Service Switchboard shall have paralleling capability between each of the generators as well as Shore Power.

The Ship's Service Switchboard shall normally distribute 480 Vac, 3-phase, to all non-emergency equipment requiring 480 Vac. Under normal conditions, the Ship's Service Switchboard shall also supply power to the Emergency Switchboard through a bus tie to an Automatic Bus Transfer (ABT) system as described in Section 89 of the Technical Specification.

90.4.4 Final Emergency Power Distribution System

Provide a Final Emergency Power Distribution System to the Vessel's final emergency loads through the Emergency Switchboard.

The final Emergency Switchboard shall be divided into two (2) sections, 480 Vac distribution and 208Y/120 Vac distribution.

The 480 Vac section of the final Emergency Power Distribution system, under normal conditions, shall be fed from the Ship's Service Switchboard through the final emergency ABT system. During times of interrupted normal Ship's Service Power, the Emergency Diesel Generator shall start, and when the generator reaches proper voltage, the ABT system will transfer its load to the Emergency Diesel Generator, as described in Section 89 of the Technical Specification.

The two (2) available power sources shall be interlocked, so that only one (1) can be connected to the final emergency bus at a time. The power shall be arranged for 480 Vac, 3-phase, 3-wire power.

The final emergency ABT system shall include a test switch to simulate the failure of power on the Ship's Service Bus, and shall initiate starting of the Emergency Diesel Generator and transfer of the automatic bus transfer system, as described in Section 89 of the Technical Specification. The ABT system shall be comprised of two (2) SQUARE D Masterpact[®] circuit breakers (one (1) to connect the Emergency Diesel Generator to the Emergency Switchboard, the other to tie the Emergency Bus to the Ship's Service Bus) controlled by a PLC as described in Section 89 of the Technical Specification.

The 208Y/120 Vac section of the final Emergency Power Distribution system, is fed by a transformer bank, consisting of three (3) single-phase, inrush current limiting, transformers, connected 3-phase, 480 Vac (delta) to 208Y/120 Vac (wye).

90.5 CIRCUIT BREAKERS

Power distribution system circuit breakers and other protective devices shall be selected, arranged and coordinated to isolate any fault in the system to the smallest possible portion of the system. The system shall be designed so that the generator breakers will be the last to open. Circuit breaker selection shall be based on the results of the Fault Current Analysis and the Coordinated Trip Analysis as required in Section 87 of the Technical Specification.

Each protective device shall have sufficient interrupting capacity to safely interrupt the maximum fault current obtainable at its point of application, but in no case of less interrupting capacity than called out in the Technical Specification.

Circuit breakers used in distribution panelboards shall be of the commercial molded case type, quick-make, quick-break, with inverse time tripping characteristics on overloads and instantaneous trip device for short circuits, except as noted.

Power panel distribution circuit breakers shall be of plug on design and of molded-case construction. Two- and three-pole-breakers shall have common trip handles. The Contractor shall confirm that the short circuit ratings of all equipment are adequate for the application and ratings of equipment that are part of the associated systems. Breakers shall clearly show when they have been tripped by overcurrent. Each breaker shall be trip free.

Circuit breakers used in the main machinery space (all spaces below the Lower Vehicle Deck, except the EOS Deck level), Sun Deck electrical distribution rooms, fan rooms, and the Emergency Diesel Generator Room distribution panels shall have their trip setting calibrated for 50C degrees. All other circuit breakers, shall have their trip setting calibrated for 40C degrees.

For WSF Fleet-wide Standardization purposes, circuit breakers shall be SQUARE D. All single-phase loads shall utilize single-pole circuit breakers for 120 Vac loads and two-pole circuit breakers for DC loads. All circuit breaker terminations shall be properly sized for the cable the breaker is feeding.

All I-LINE[®] style circuit breakers in switchboards and feeder distribution panels shall have toggle locking brackets to allow locking a circuit breaker in the open position.

90.6 DISTRIBUTION PANELS

90.6.1 General

For WSF Fleet-wide Standardization purposes, all distribution panels provided shall be manufactured by the SQUARE D Company, shall be Underwriters Laboratories (UL) listed, and shall bear the UL label.

NOTE: UL will not allow labeling of panels having circuit breakers calibrated for other than 40C degrees. Panel requiring 50C degree circuit breakers in accordance with USCG requirements **will not** require a UL label, but must be certified by SQUARE D as meeting all other applicable UL requirements.

Each panel board having 50C degree calibrated circuit breakers shall have the rating of the panel de-rated for 50C degree conditions and shall be so labeled.

Each panelboard, as a complete unit, shall have a short circuit current rating equal to or greater than (\geq) the integrated rating of the equipment fed from that panelboard. This rating shall be established by testing with the over current devices mounted in the panelboard. The method of short circuit testing shall be as specified in UL Standard 67.

1 Each panel shall be labeled with its maximum short circuit current rating at rated
2 temperature and voltage.

3 All power and lighting distribution panels shall not be mounted accessible to Passengers
4 and shall have latches equipped with keyed alike, vault-type locks.

5 **90.6.2 Enclosures**

6 Provide panel assemblies enclosed in steel cabinets. The rigidity and gauge of the steel
7 shall be as specified in UL Standard 50 for cabinets.

8 All distribution panels shall have an electrostatically deposited baked enamel finish, or
9 powder coated system over cleaned phosphate primed steel. The color shall be "METER
10 GRAY" (ANSI No. 49) powder coat.

11 All electrical power and lighting distribution panel enclosures shall be classed as
12 specified in Section 87 of the Technical Specification. All electrical power and lighting
13 distribution panels located on the Vehicle Decks, in the machinery spaces, in the Sun
14 Deck electrical distribution rooms and fan rooms, in the Emergency Diesel Generator
15 Room or any other wet or damp location shall be NEMA 12. All other lighting
16 distribution panels may be NEMA 1, dripproof.

17 NEMA 1 panels shall have adjustable indicating trim clamps which shall be completely
18 concealed when the doors are closed. NEMA 1 panel fronts shall be fitted with catches
19 and spring loaded stainless steel door pulls. NEMA 1 enclosure fronts shall be fitted with
20 cylinder tumbler type locks which shall be of the flush type and shall not protrude
21 beyond the front of the door. Lighting distribution panel fronts shall not be removable
22 with the door in the locked position. NEMA 1 electrical distribution panels shall be flush
23 mounted wherever possible. Knockouts **shall not** be permitted in these enclosures.

24 NEMA 12 panels shall have fully gasketed doors. NEMA 12 lighting distribution panel
25 doors shall have vault locks and trunk latches. Power distribution panels and load centers
26 shall have three-point latches and "vault" locks. Power distribution panel fronts **shall**
27 **not** be removable with the door in the locked position. Knockouts **shall not** be permitted
28 in these enclosures.

29 Provide dead front panelboards incorporating switching and protective devices of the
30 number, rating and type noted herein. All panelboards shall be rated for the intended
31 voltage and shall be in accordance with the Underwriters' Laboratories, Inc., "*Standard*
32 *for Panelboards*" and "*Standard for Cabinets and Boxes*" and shall be so labeled.
33 Panelboards shall also comply with NEMA Standard for Panelboards, and National
34 Electric Code where applicable.

35 All power and lighting distribution panels shall be keyed alike.

1 All panelboard interiors shall be completely assembled before delivery to the Contractor
2 with switching and protective devices, wire connectors, etc. All wire connectors, except
3 screw terminals, shall be of the anti-turn solderless type and all shall be suitable for
4 copper wire.

5 Panelboard interiors shall be designed such that switching and protective devices can be
6 replaced without disturbing adjacent units and without removing the main bus connectors
7 and shall be so designed that circuits may be changed without machining, drilling or
8 tapping.

9 Branch circuits shall be arranged using double row construction.

10 Bus bars for the mains shall be of copper sized in accordance with Underwriters'
11 Laboratories Standards. See Section 87 of the Technical Specification for additional
12 requirements as to installation and construction.

13 Each power distribution panel shall be provided with main lugs only.

14 Phase bussing shall be full height without reduction. Cross and center connectors shall
15 be copper.

16 Doors on panelboard shall not uncover any live parts in making switching device handles
17 accessible.

18 A "WHITE" on "BLACK" phenolic nameplate shall be provided listing panel type and
19 ratings for each panelboard. Provide engraved and filled (or color layer engraved
20 through outer layer) phenolic nameplate with 1/2-inch high characters (for panel name);
21 3/8-inch high characters for other information; attach with screws to each panelboard
22 front. Include full panel designation, panel voltage, bus rating, number of phases
23 (identify which phase if single-phase panel), wire and short circuit interrupting capability
24 rating (i.e., P6-403, Engine Room No. 1 Power Panel, 480 V, 225 Amp Bus, 3-Phase, 3-
25 Wire, 18,000 A.I.C). See Section 24 of the Technical Specification for additional
26 labeling requirements.

27 A "WHITE" on "BLACK" phenolic circuit breaker directory label shall be attached with
28 screws to the outside front of each power and lighting panel door listing the circuit
29 breaker number, function of the circuit, current rating of the circuit breaker, and relative
30 location of the circuit breaker found within. Letters and numbers shall be at least 1/8 inch
31 high.

32 Individual "WHITE" on "BLACK" phenolic labels shall be attached with screws next to
33 each circuit breaker of each power and lighting panel listing the circuit breaker number,
34 function of the circuit, and current rating of the circuit breaker. Letters and numbers
35 shall be at least 1/8 inch high.

A circuit directory frame and card with a clear plastic covering shall be fitted on the inside of each distribution panel door as required by 46 CFR §111. The directory card **shall not** be permanently attached to the door and shall be removable for changing or modifications. The directory card shall provide a space at least ¼-inch high × 2 inch column width for each circuit feed from the distribution panel. The circuit designations and load description of the circuit shall be typed in the proper place provided on the directory card. The circuit designations and load description shall correspond **EXACTLY** to the FINAL AS-BUILT One-Line Diagram.

All electrical power and lighting distribution panels shall be sized to contain spares as required in Section 87 of the Technical Specification for additional requirements as to installation and construction.

90.6.3 HCM and HCN Power Distribution Panels

Provide power distribution panels manufactured by the SQUARE D Company, Class 2110, I-LINE[®], Type HCM or HCN panelboards, as specified, for 480 Vac, 60 Hertz, 3-phase, 3-wire service.

The 208Y/120 Vac load center panels shall be SQUARE D Company, Class 2110, I-LINE[®], Type HCN, panel boards rated for 480 Vac, 60 Hz, 3-phase, 4-wire.

90.6.4 HCM and HCN Bus Assembly

Provide panel busing of the distributed phase sequence type. The buses shall be made of copper and electrolytically tin- or silver-plated.

Three-phase bussing shall be such that any three (3) adjacent circuit breaker poles are individually connected to each of the three phases so that three-pole breakers can be installed at any location.

Bus structures shall have current ratings as required to fully protect the circuits served, in accordance with UL Standard 67.

Bus ratings for panels installed in the main engineering spaces, Sun Deck electrical distribution rooms and fan rooms, and the Emergency Diesel Generator Room shall be based on 50C degrees ambient temperature.

90.6.5 HCM and HCN Panel Circuit Breakers

Provide power distribution panels with SQUARE D, Class 650, thermal-magnetic, molded case, Type FA, FH or FC circuit breakers or Class 655 type KA, KH or KC of the ratings required for complete protection of the circuits served. Circuit breakers shall be equipped with individually insulated, braced and protected connectors. The front faces of all circuit breakers shall be flush with one another.

Tripped indication shall be clearly shown by the breaker handle taking a position between "ON" and "OFF". Circuit breakers shall be trip free.

Circuit breakers installed in the main engineering spaces, except the EOS Deck level, Sun Deck electrical distribution rooms and fan rooms, and the Emergency Generator Room shall have their trip settings calibrated for 50C degrees ambient.

Large, permanent, individual circuit breaker identification plates shall be affixed near each breaker in a uniform position and shall show the circuit number, breaker frame rating and type, breaker trip setting, and name of load served.

Terminals for all conductors, both feeder and branch circuits, shall be UL listed as suitable for copper conductor material. Circuit breakers shall be equipped with individually insulated, braced and protected connectors.

90.6.6 HCM and HCN Panel Safety Barriers

Each panel interior assembly shall be dead front with the panel front removed. The barrier in front of the main lugs shall be hinged to a fixed part of the interior.

90.6.7 NF Distribution Panels

Provide lighting and power distribution panels manufactured by the SQUARE D Company, Class 1670, Type NF rated for 208Y/120 Vac max., 250 Amps, 60 Hz, 3-phase, 4-wire service, for all 208Y/120 Vac distribution.

Circuits that require grounds shall be grounded in accordance with 46 CFR §111 and Section 87 of the Technical Specification. Ensure that all grounding required is provided through a single conductor of an appropriate size and that the length of the conductor is as short as is physically practicable.

Terminals for all conductors, both feeder and branch circuits, shall be UL listed as suitable for copper conductor material.

1 90.6.8 NF Panel Bus Assembly

2 Provide panel bus bar connectors to the branch circuit breakers of the distributed phase
3 sequence type. Panel busing shall be rated at no less than 250 Amps and shall be sized to
4 a greater capacity if required by the total panel load. All current carrying parts of the bus
5 assembly shall be of hard-drawn copper electrostatically silvered or tin plated.

6 Distribution panels shall be provided with main lugs only, unless otherwise specified.

7 Three-phase busing shall be such that any three (3) adjacent circuit breaker poles are
8 individually connected to each of the three phases in such a manner that 3-pole breakers
9 can be installed at any location.

10 90.6.9 NF Panel Circuit Breakers

11 Provide distribution panels equipped with SQUARE D, Class 1210, Type EDB quick-
12 make, quick-break, thermal-magnetic, trip indicating circuit breakers as well as
13 Type ECB-G3 remotely operated POWER LINK circuit breakers.

14 All 208 Vac single-phase and DC breakers shall be two-pole type. All 120 Vac
15 single-phase circuit breakers shall be single-pole type.

16 The circuit breakers shall have a 14,000 Amp (minimum) RMS symmetrical - UL listed
17 interrupting rating.

18 See Section 92 of the Technical Specification for a description of POWER LINK
19 remote-controlled lighting circuit breakers.

20 90.6.10 Panel Phase Balancing

21 208Y/120 Vac, 4-wire panels serving 208 Vac or 120 Vac single-phase loads shall have
22 the loads distributed to balance the phases as required in Section 87 of the Technical
23 Specification.

24 **NOTE: The Contractor shall be responsible for balancing the loads to within**
25 **15-percent (15%) deviation from the average of the three (3) phases.**
26 **See Section 87 of the Technical Specification for a relaxation of this**
27 **requirement for lightly loaded panels.**

28 90.6.11 Food Preparation and Small Galley Area Power

29 Provide a complete load center to provide power for equipment in a Food Vending and
30 Small Galley areas (see **FIGURE 90-1** at the end of this Technical Specification
31 Section).

Power provided shall be a 480 Vac, 3-phase power panel and a SQUARE D NQOD 208Y/120 Vac load center.

See the *CABLE INSTALLATION* Subsection in this Section of the Technical Specification for the remainder of the installation.

90.6.12 24 Vdc Topside Navigation Electronics Power Distribution Panel

Provide two (2) 24 Vdc Panels for navigation electronic loads topside. These panels shall be for direct current and powered from dedicated batteries and power supplies. (See Section 96 of the Technical Specification).

The 24 Vdc power distribution panels shall be NQOD distribution panels with two-pole circuit breakers of the appropriate rating. Panels shall meet all requirements of this Section of the Technical Specification. The panel shall be single-phase, 2-wire.

Circuit breaker and panel labeling shall be similar to the NQOD panel labeling requirements specified in the *Enclosures* Subsection above, and Section 24 of the Technical Specification.

Locate one (1) panel in each Pilothouse.

Provide a ground detection system with local indication and remote indication in the EOS.

90.6.13 24 Vdc IC Distribution Panel

Provide one (1) 24 Vdc Panel for general IC loads and locate in the Electrical Distribution Room on the Lower Vehicle Deck. This panel shall be for direct current and powered from dedicated batteries and power supplies. (See Section 96 of the Technical Specification).

The 24 Vdc power distribution panels shall be an NQOD distribution panel with two-pole circuit breakers of the appropriate rating. Panels shall meet all requirements of this Section of the Technical Specification. The panels shall be single-phase, 2-wire.

Circuit breaker and panel labeling shall be similar to the NQOD panel labeling requirements specified in the *Enclosures* Subsection above, and Section 24 of the Technical Specification.

Provide a ground detection system with local indication and provide interface with the PSI Contractor's AMS.

90.6.14 24 Vdc Propulsion Control and AMS Distribution Panels

Provide two (2) 24 Vdc panels for propulsion control and AMS loads and locate in the EOS. These panels shall be direct current and powered from two (2) dedicated battery banks, each with its own power supply.

The 24 Vdc power distribution panels shall be NQOD distribution panels with two-pole circuit breakers of the appropriate rating. Panels shall meet all requirements of this Section of the Technical Specification. The panels shall be single-phase, 2-wire.

90.6.15 12 Vdc Radio Distribution Panels

Install an Owner Furnished Equipment (OFE) 12 Vdc Radio Distribution Panel System in General accordance with the guidance as set forth in **VOLUME V, OWNER FURNISHED EQUIPMENT**.

90.6.16 24 Vdc Emergency Diesel Generator Starting Battery Distribution Panel

Provide a 24 Vdc Emergency Diesel Generator starting battery distribution panel and locate in the Emergency Diesel Generator Room.

The 24 Vdc power distribution panels shall be SQUARE D NQOD distribution panels with two-pole circuit breakers of the appropriate rating. Panels shall meet all requirements of this Section of the Technical Specification. The panels shall be single-phase, two-wire.

90.7 TRANSFORMERS

Provide 480 Vac to 208Y/120 Vac 3-phase transformer banks consisting of three (3) TIERNEY ELECTRICAL MANUFACTURING Company, or equal, single-phase enclosed drip-proof, dry type, non-ventilated transformers.

Connect the transformers for 480 Vac, 3-phase, 3-wire, delta primaries and 208Y/120 Vac, 3-phase, 4-wire, wye secondaries.

The transformers shall be of continuous wound construction with electrostatic, and tap arrangements in the high voltage windings.

Individual transformer banks rated below 25 KVA shall have two (2) taps, each 5-percent (5%) full capacity below normal (FCBN).

Individual transformers rated for 25 KVA and above shall have six (6) taps, each 2½-percent (2½%) of full capacity arranged two (2) above and four (4) below nominal.

All insulating materials shall be in accordance with NEMA Standard ST 20.

Transformers shall be rated for temperature rises of no more than 80C degrees, with Class H, or better, insulation.

Transformer sound levels shall not exceed 45 dbA at full rated capacity three (3) feet from the transformer.

All transformers shall be in compliance with the applicable NEMA, IEEE and ANSI standards including, but not limited to, NEMA TR 27-1965 R 1971, ANSI/UL 506 and ANSI C57.12.01.

Arrange the transformer banks so transformers are side by side with adequate spacing between transformers for cooling, and provide a wiring gutter above or below the bank with flex conduit between the gutter and the transformer housings. All interconnections between the transformers shall be made inside the gutter box. Cable may be spliced onto the transformer leads to lengthen them as needed to reach the box. This arrangement shall provide for easy removal of any of the three (3) transformers for replacement. It is recommended that no less than six (6) inches be provided between any two (2) transformers unless the manufacturer recommends greater spacing.

Components shall be grounded in accordance with 46 CFR §111 and this Section of the Technical Specification. Ensure that grounding is provided through a single conductor of an appropriate size and that the length of the conductor is as short as is physically practicable. Ground neutrals of wye connected transformers to the Vessel's hull structure at the transformer bank. The shield shall also be grounded to the Vessel's structure near the panel. Different ground cables shall be used for the neutral ground and the shield ground.

Provide ground current C.T.s on the neutral ground lead of the transformers with the indicating meters required by 46 CFR §111. Current transformers associated with the ground current detection system shall be installed in the wiring gutters serving the transformers. A Metal Oxide Varistor (MOV), or similar type over-voltage protection device, shall be located in the vicinity of, and installed across the leads of each current transformer, to protect the current transformers from an open circuit condition at the output. Shorting terminals, using a plug in shorting device, shall be provided for each ground current C.T.

90.8 RECEPTACLES AND SWITCHES

90.8.1 Receptacles

115 volt general purpose receptacles for portable equipment shall be provided in all spaces, including Holds, Vehicle Decks, Crew's quarters, MES Stations, and Passenger cabin areas, except hazardous zones. Each space and each work bench within that space, except in hazardous areas, shall have at least one (1) unassigned receptacle.

1 **90.8.1.1 Interior Spaces**

2 All Interior spaces shall be provided with receptacles in numbers and locations
3 adequate to provide complete coverage of the space by portable appliances, tools
4 or lights equipped with cords of not more than twenty-five (25) feet in length. In
5 the Passenger cabin, in addition to the above mentioned receptacle requirements,
6 all booth seating areas with tables shall be provided with a receptacle to plug a
7 computer into, and every other booth area without tables shall be provided with a
8 receptacle to plug a computer into. Pilotheuses shall have a minimum of three (3)
9 receptacles.

10 **90.8.1.2 Weather Deck Areas**

11 Weather Deck areas shall be provided with waterproof receptacles in numbers and
12 locations adequate to provide complete coverage of the deck areas by portable
13 appliances, tools or lights equipped with cords of not more than forty (40) feet in
14 length.

15 In general, 115 volt receptacles shall be the duplex type except that watertight or
16 explosion proof receptacles and receptacles on the Weather Decks may be single unit
17 type. All receptacles installed in machinery spaces or in open deck areas shall be
18 watertight. Receptacles in spaces where they may be exposed to mechanical injury shall
19 be watertight.

20 All receptacles installed in Cleaning Gear Lockers, Passenger and Crew Restroom areas,
21 and at work and test benches, shall be GFI type duplex receptacles, hospital grade or
22 better, LEVITON 6198-HGT, or equal. All receptacle circuits shall be on 20 Amp circuit
23 breakers and receptacles shall be rated at 20 Amps.

24 Unless otherwise specified, duplex receptacles shall be NEMA Type 5-20R specification
25 grade devices rated for copper wire, 125 volts, 20 Amps, grounded, side wired, with
26 screw terminals. ***Push-in type connections are not acceptable.***

27 Receptacles or switches mounted in "Marinite" type lining panels or non-structural
28 bulkheads shall be mounted with cover plates for the switches or receptacles flush with
29 the surface of the lining panel or non-structural bulkhead wherever possible without
30 adversely affecting the aesthetics of the space where installed. Each switch or receptacle
31 so installed shall be provided with a steel support or reinforcing plate on the obverse side
32 of the lining or non-structural bulkhead. The plate shall be no less than #12 gauge
33 material. The fasteners used to attach the wiring device enclosure to the plate shall be
34 corrosion resistant and of a type which will preclude their coming loose and falling into
35 inaccessible locations. In no case shall the liner or non-structural bulkhead be used as the
36 sole means of support for switch or receptacle enclosures.

Switch and receptacle support or reinforcement plates shall be galvanized, corrosion resistant, or preserved as required by Section 14 of the Technical Specification. Where the plates are exposed they shall be painted to match the adjacent surface as outlined in Section 25 of the Technical Specification.

Each receptacle enclosure shall be bonded to the nearest grounded receptacle enclosure or connection box, with an integral grounding conductor connected between grounding screws. A short grounding conductor shall be connected directly to the receptacle grounding screw and the enclosure grounding screw. In no case shall the receptacle mounting screws be used as the ground path to the receptacle enclosure.

For WSF Fleet-wide Standardization purposes, watertight receptacles for use on open decks and in machinery spaces shall be duplex PAULUHN #2634BU-125, or single PAULUHN #2632BU-125.

Drinking fountains shall be hard wired to connection boxes that shall in turn be fed from the nearest receptacle circuit.

For WSF Fleet-wide Standardization purposes, provide a PAULUHN 6008B-250 receptacle and a PAULUHN 6008B-480 receptacle in the Engineer's Work Shop for test purposes.

For WSF Fleet-wide Standardization purposes, provide one (1) PAULUHN 6008B-250 receptacle in each fire zone, on each deck above the Upper Vehicle Deck, and one (1) receptacle in each space between watertight bulkheads in the hold. Provide four (4) receptacles equally spaced on each of the Vehicle Decks.

For WSF Fleet-wide Standardization purposes, provide two (2) PAULUHN 6008B-480 receptacles in the Emergency Generator Room.

90.8.2 Switches

Switches shall be specification grade, 125 volt, 15 Amp, with handle set vertically. The "UP" position shall correspond to "ON" for **all** toggle switches unless the switch is installed in a 3- or 4-way switching configuration. All single-phase load switches shall be double-pole. Watertight switches shall be used in the Engine Rooms, Steering Gear Rooms, Tank Rooms, and in all locations where the switches may be exposed to weather, water, or spray.

For WSF Fleet-wide Standardization purposes, unless otherwise specified, switches used in the Pilothouse Control Console to control exterior lighting circuits shall be BRYANT Model 5862 or 5863 as appropriate for maintained contacts, and BRYANT Model 5862-M and 5863-M, as appropriate for momentary contacts.

The Pilothouse switches for control of the casing and Picklefork fire door holdback magnets shall be two-position, maintained, "RED" illuminated selector switches with two

(2) normally open (NO) DC rated contacts each, TELEMECANIQUE Type XB2 B, 22mm, Model ZB2BK124 with contacts ZB2BW063, or equal. See Section 95 of the Technical Specification for additional guidance on fire door magnets.

The Pilothouse switches for control of the Rescue Boat station and High Slide Marine Evacuation Systems (MES) flood lights and the High Slide Marine Evacuation Systems (MES) strobe lights shall be two (2) button, momentary, "AMBER" neon illuminated push buttons with two (2) normally open DC rated contacts each, TELEMECANIQUE Type XB2 B, 22mm, Model ZB2BW81354 with contacts ZB2BZ103, or equal. See Section 92 of the Technical Specification for additional guidance on the flood lights.

The Pilothouse switches for the flood light control panel, window heater control, forward end Passenger Cabin, Sun Deck, and Vehicle Deck lights, shall be located on the console top in a location as directed by the WSF Representative, and shall be a double-pole, illuminated, "RED" handle toggle switch, rated 120 Vac, 20 Amp, ARROW HART Model 1992PL, or equal. See Section 92 of the Technical Specification for additional guidance on flood lights.

Illumination of pilot lights and switch handles shall indicate when the device controlled is energized.

Each switch enclosure shall be wired back to the nearest grounded electrical enclosure or connection box with an integral grounding conductor connected between grounding screws. A short grounding conductor shall be connected directly to the switch grounding screw and the enclosure grounding screw. In no case shall the switch enclosure mounting screws be used as the ground attachment point.

90.9 IMPRESSED CURRENT SYSTEM

Provide a permanent cathodic protection system for the Vessel. The salient features of the system shall include:

1. **Automatic operation:** The system shall be capable of regulation of the level of protection while the Vessel is underway, loading and unloading vehicles, and tied up for short and extended periods of time without manual adjustment. The system shall also be capable of detecting and correcting for changes in the environment including water salinity, changes in Vessel draft (immersed hull area), temperature of water, and hull coating condition.
2. Overprotection safeguards to ensure that the hull and the hull painting system shall not be damaged.
3. Service life of the system designed for a minimum of twenty (20) years for internal components and ten (10) years for exterior hull components.

For WSF Fleet-wide Standardization purposes, provide a USFILTER Electrochemical (formerly ELECTROCATALYTIC INCORPORATED) automatic impressed current cathodic protection system consisting of the following major units at a minimum:

1. One (1) each, automatic #58613-002 power supply. Input: 460 Vac, 60 Hz, 3-phase, Output: 200 Amp, 28 Vdc.
2. Four (4) each, 4-Foot #36460-1 Platinum/Niobium anodes.
3. One (1) each Ag/AgCl #32622 reference cell.
4. Two (2) each propulsion shaft #37000-4 grounding assembly.

Anodes shall have “blown fuse” indicators on the fuse holders.

In addition, provisions shall be made for grounding the two (2) rudder posts. Each rudder post shall have dual grounding straps.

The Contractor shall provide all interconnecting wiring and junction boxes to the specifications of the cathodic protection system vendor.

The installation and initial testing of this system shall be in strict accordance with the equipment manufacturer's instructions, except that the dimensions of the Capacitive shield painted around the hull anodes shall be 1.5 times the manufacturer's recommended dimensions. See Section 14 of the Technical Specification.

Anode installation, reference cell installation final system installation, set up, and testing shall be under the direct supervision of a USFILTER Electrochemical Representative.

Contact for USFILTER Electrochemical is (908) 851-2277; Email: electrochemical@usfilter.com.

90.10 RAMP POWER FEEDBACK RECEPTACLES

For WSF Fleet-wide Standardization purposes, provide an APPLETON ELECTRIC Company Type SR, Model DBR6034DS, 3-wire, 4-pole, 600 volt, 60 Amp, dead front receptacle with integral disconnect switch at each End of the Vessel.

Ensure that it shall be impossible to energize the receptacles unless the plug is fully inserted and locked. The plug shall mechanically lock in place when energized.

Provide a laminated phenolic sign, EMERGENCY RAMP AND FEEDBACK POWER RECEPTACLE near the receptacle. Letters shall be at least one (1) inch in height and in colors required by this Section and Section 24 of the Technical Specification.

Feed power to this circuit from the Ship's Service Switchboard.

90.11 SHORE POWER CONNECTIONS

The Shore Power connections shall be divided into two (2) separate feeders, one (1) on each End of the Vessel. The Shore Power feeder on each End of the Vessel shall be connected to a common, manual transfer switch for Ship's Service power. The manual transfer switch shall select whichever End of the Vessel has Shore Power connected and supply power to the Shore Power circuit breaker located in the Ship's Service Switchboard. All Shore Power plugs, receptacles, cords, and junction boxes shall be identical.

Provide cables from each Shore Power junction box and a double throw, manual transfer switch, SQUARE D Catalog No. 82344, 3-pole, 480 Vac, 200 Amp, not fusible, in a NEMA 12 enclosure located in the EOS deck area as approved by the WSF Representative. Connect the cable to top terminals to the No. 1 End and the bottom terminals to the No. 2 End. Provide a cable to connect the transfer switch output feeder to the Shore Power circuit breaker in the Ship's Service Switchboard.

Provide a cable stowage rack, convenient to the Shore Power receptacle, on each End of the Vessel. For WSF Fleet-wide Standardization purposes, provide a "dummy" APPLETON ELECTRIC Type AJA mounting boxes, without internal receptacle or wiring, to serve as a watertight storage for the "shore end" of the cable, while the Vessel is in service. Locate the "dummy" receptacles, and provide cable stowage racks, convenient to the Shore Power connection box on each End of the Vessel.

For WSF Fleet-wide Standardization purposes, provide one (1) watertight Shore Power cable APPLETON ELECTRIC ADJA20033-150 plug-in receptacle at each End of the Vessel. Locate the receptacles inboard of the Upper Vehicle Deck ramp, on the curtain plate at the Main Deck (Lower Vehicle Deck). Each receptacle shall be sized for 250 Amps at 600 Vac to complete the Shore Power connection. The lug terminals permanently mounted inside the junction box shall be labeled for phase "A", "B", and "C" to aid in proper connection of the Shore Power cable. It is intended to be able to move the Shore Power cable from one End of the Vessel and plug it in on the opposite End of the Vessel in the event one cable becomes damaged. Provide cable from these junction boxes to the manual transfer switch. The switchboard circuit breaker for the Ship's Service feeder shall be draw-out type, electrically charged, stored energy operated circuit breaker, with a frame rating of 800 Amps and a thermal trip setting of 150 Amps, SQUARE D Masterpact® NW. The circuit breaker shall be identical to the other draw-out circuit breakers mounted in the Ship's Service Switchboard.

Provide two (2) Shore Power cables, each consisting of 100 feet of Type GGC, or equal, 600 volt, No. 1, three-conductor cable with ground. For WSF Fleet-wide Standardization purposes, provide an APPLETON ELECTRIC Type AP20033CD clamping ring plug on each end of the cable. The Shore Power cables shall be properly stowed in the adjacent rack, at the time of the Vessel's delivery. All lugs and terminal connection devices shall be rated for 200 Amps, 600 Vac.

90.12 CABLE INSTALLATION

All cables shall be selected and installed in accordance with the approved system Electrical One-Line Diagram and Voltage Drop Calculations. See Section 87 of the Technical Specification for cable type, installation, and identification requirements.

The Contractor shall develop detailed wireway and cable installation drawings, including rack and rotation drawings for cable installation. Each system drawing shall include a cable routing table, giving the wireway routing and MCT penetrations of each cable. These routing tables shall correlate with a Master Cable Routing Plan.

Power and lighting cables shall be double banked in bundles of six (6). All power and lighting cables shall be de-rated in accordance with the published ampacity for the correct ambient temperature.

Type SO cable may be used for the short flexible cables to the final connections to the trainable floodlights and searchlights.

Each electrical device shall be directly connected to the circuit breaker protecting the equipment unless a receptacle is specifically called for by the Specification.

Cable installed on the inside back panels of the Small Galley and Crew food preparation counters shall be run in conduit, for mechanical crush protection. EMT is suitable for use as conduit. Other type of mechanical protection may also be suitable if approved in writing by the WSF Representative.

90.13 CABLE IDENTIFICATION

Identify each cable as set forth in Section 87 of the Technical Specification.

90.14 ELECTRICAL GROUNDING AND BONDING

See Section 87 of the Technical Specification for bonding and grounding requirements.

The Contractor shall closely follow the manufacturers' instructions for grounding of the shafting and rudder posts, and as specified in this Section of the Technical Specification.

Provide grounding systems complying with 46 CFR §111 and the codes and ordinances specified.

90.15 SPARE PARTS AND INSTRUCTION MANUALS

Provide a list of recommended spare parts and special tools for those items which are Contractor furnished, together with parts lists and instruction manuals necessary to maintain

and service provided equipment and accessories in accordance with the requirements of Sections 86 and 100 of the Technical Specification.

90.16 TESTS, TRIALS, AND INSPECTIONS

Tests and/or trials shall be in accordance with this Section and Section 101 of the Technical Specification.

Inspections shall be performed as defined in this Section and Section 1 of the Technical Specification.

90.17 PHASE II TECHNICAL PROPOSAL REQUIREMENTS

The deliverables required by Section 100 of the Technical Specification and the Authoritative Agencies, shall be provided during the Phase II Technical Proposal stage of Work in accordance with the requirements of Section 100 of the Technical Specification:

See Section 100 of the Technical Specification for additional requirements regarding technical documentation.

90.18 PHASE III DETAIL DESIGN AND CONSTRUCTION REQUIREMENTS

The following deliverables, in addition to other deliverables required by Section 100 of the Technical Specification and the Authoritative Agencies, shall be provided during the Phase III Detail Design stage of Work in accordance with the requirements of Section 100 of the Technical Specification:

A. Booklet of Electrical Panels

B. DAPPER Project File

The deck wiring plans and elementary wiring diagrams required by Section 100 of the Technical Specification shall address the various electrical systems and circuits for which plan submittals are required by the Authoritative Agencies.

The ***Booklet of Electrical Panels*** shall list, by type and location, each panel on the Vessel and **all** items served by each branch circuit breaker, fuse or switch.

NOTE: The above deliverable is one of the options available in the DAPPER Suite of Programs.

Electrical Power Generating and Distributions Systems Schematic Drawing(s) shall include identification and location of all panels, switchboards, load centers, motor control centers, remote I/O, local operating panels (LOP's), local engine panels (LEP's), transformers, circuit breakers, transfer switches, and cable sizes. All principal loads shall be

- 1 identified and descriptions of motors, motor controllers and motor control centers (MCCs)
- 2 provided.
- 3 See Section 100 of the Technical Specification for additional requirements regarding
- 4 technical documentation.

(END OF SECTION)